Sensitivity, specificity, and usefulness of the Dutch Fatigue Scale

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Sensitivity, Specificity, and Usefulness of the Dutch Fatigue Scale

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PURPOSE. *To test the sensitivity, specificity, and usefulness of the Dutch Fatigue Scale (DUFS), which is based on NANDA's defining characteristics of* fatigue.

METHODS. *A cross-sectional design was used among domiciliary patients (*N = *213) with chronic heart failure (*n = *138) and with breastfeeding postpartum women (*n = *75).*

FINDINGS. *Calculations of the sensitivity and specificity of the DUFS, comparisons of the average DUFS sumscores between both nonfatigued and fatigued subjects, as well as between patients with chronic heart failure and postpartum women, and correlation coefficients performed with sociodemographic factors (age, gender, education) demonstrate acceptable psychometric properties.*

CONCLUSIONS. *The DUFS is a reliable and valid measurement tool for the assessment of fatigue.*

PRACTICE IMPLICATIONS. *Accurate recognition of the existence and extent of fatigue must precede interventions. Easy to use, reliable tools for the bedside nurse are invaluable assets to practice.*

Search terms: *Fatigue, measurement of fatigue, psychometric testing*

Sensibilité, spécificité et utilité de l'Échelle de Fatigue Hollandaise

BUT. *Vérifier la sensibilité, la spécificité et l'utilité de l'échelle de fatigue hollandaise (DUFS) basée sur les caractéristiques du diagnostic infirmier* fatigue *(NANDA).*

MÉTHODES. *Une étude transversale fut réalisée auprès de malades insuffisants cardiaques à domicile (*n = *138) et auprès de femmes allaitantes (*n = *75).*

RÉSULTATS. *Les calculs de la sensibilité et de la spécificité de DUFS, les comparaisons des moyennes des scores de DUFS entre les sujets fatigués et non fatigués des deux groupes (insuffisants cardiaques et femmes allaitantes) et les coefficients de corrélation obtenus avec les facteurs socio-démographiques (âge, sexe, éducation) démontrent que cette échelle a des propriétés psychométriques acceptables.*

CONCLUSIONS. *L'échelle de fatigue hollandaise est un outil fiable et valide pour évaluer la fatigue.*

Mots-clés: *Fatigue, mesure de la fatigue, test psychométrique*

Sensitivity, Specificity, and Usefulness of the Dutch Fatigue Scale

テーマ：オランダ版消耗性疲労スケールの感受性および特質、有効性の検討

問　題：NANDAの＜消耗性疲労＞の診断指標を基に作成したオランダ版消耗性疲労スケール（DUFS）の感受性およびその特性、有効性について検討する。

方　法：在宅で療養している慢性心疾患を有する患者（n=138）と産後の授乳（母乳）時にある母親（n=76）を対象に横断的調査を行った。

結　果：コントロール群のDUFS得点を算出し、＜消耗性疲労＞のない者とある者との間のDUFS値の平均値を比較をした。同じように、DUFS得点の平均値を慢性心疾患患者と産後の授乳期にある母親のものとを比較した。またそれらの平均値と社会的人口的要因（年齢、性別、教育）との相関係数が、計量心理学上の属性として有効であることを示唆した。

結　論：オランダ版消耗性疲労スケールは、患者の＜消耗性疲労＞を測定する上で、適切性かつ妥当性がある測定ツールであると考える。

実践への適応：＜消耗性疲労＞の正確な存在や範囲（程度）の認識は介入にとって重要なことである。また、ベッドサイドの看護婦にとって簡単に使用でき、しかも信頼性のあるツールは、実践での貴重な財産である。

探索用語：消耗性疲労、消耗性疲労の測定、計量心理学検査

Sensibilidade, especificidade e utilidade da Escala Holandesa de Fadiga

OBJETIVO. *Testar a sensibilidade, especificidade e utilidade da Escala Holandesa de Fadiga (DUFS), que é baseada nas características definidoras da NANDA para* fadiga.

MÉTODO. *Um estudo de séries cruzadas foi utilizado entre pacientes domiciliares portadores de insuficiência cardíaca crônica* (n = *138) e com mulheres puérperas em aleitamento* (n = *75).*

ACHADOS. *Cálculos da sensibilidade e especificidade da DUFS, comparações da média da soma de escores da DUFS tanto entre não portadores, bem como entre pacientes com insuficiência cardíaca crônica e mulheres puérperas e coeficientes de correlação realizados com fatores sociodemográficos (idade, gênero, escolaridade) demonstraram propriedades psicométricas aceitáveis.*

CONCLUSÕES. *A DUFS é uma ferramenta de mensuração válida e confiável para a avaliação da fadiga.*

IMPLICAÇÕES PARA A PRÁTICA. *O reconhecimento acurado da existência e extensão da fadiga deve preceder intervenções. Instrumentos confiáveis, fáceis de usar, são recursos inestimáveis para a prática da enfermeira assistencial.*

Palabras para busca: *Fadiga, mensuração da fadiga, testes psicométricos*

Sensibilidad, especificidad y utilidad de la Escala Holandesa de Fatiga (DUFS)

PROPÓSITO. *Probar la sensibilidad, especificidad, y utilidad de la Escala Holandesa de Fatiga (DUFS), que está basada en las características definitorias de* fatiga *de la NANDA.*
MÉTODOS. *Se utilizó un diseño de corte transversal, entre pacientes en su domicilio (*N = *213) con deficiencia cardíaca crónica (*n = *138) y mujeres de postparto en período de lactancia (*n = *75).*
RESULTADOS. *Los cálculos de la sensibilidad y especificidad del DUFS, comparando las puntuaciones de la DUFS, con los promedios obtenidos entre ambos tipos de sujetos, con fatiga y sin fatiga, así como entre pacientes con deficiencia cardíaca crónica y con mujeres de postparto en período de lactancia y los coeficientes de correlación realizados con factores sociodemográficos (edad, género, educación), demuestran propiedades de psicométricas aceptables.*
CONCLUSIONES. *La DUFS es una herramienta de medida fiable y válida para valorar la fatiga.*
IMPLICACIONES PARA LA PRACTICA. *Un reconocimiento exacto de la existencia y magnitud de la fatiga, debe preceder a las intervenciones. Herramientas fiables y fáciles de usar por la enfermera asistencial, son recursos inestimables para la práctica.*
Términos de búsqueda: *Fatiga, ensayo psicométrico, medida de fatiga*

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Valid and reliable measuring instruments are relevant in research and clinical practice for the purpose of precise and accurate diagnosis of phenomena. In the case of the nursing diagnosis of *fatigue,* a practical and useful instrument is lacking.

The accurate judgment of fatigue through research makes it possible to conceptualize fatigue, find factors related to fatigue, and build research models and theories that describe the course of the fatigue process and possible explanations for the reasons for fatigue (Berger & Walker, 2001; Dzurec, 2000; Fu, LeMone, McDaniel, & Bausler, 2001; Tiesinga, Dassen, & Halfens, 1997a; Trendall, 2000, 2001). In clinical practice, the assessment of fatigue may be applied individually as a management tool for planning interventions. Efficient self-care management of fatigue increases effective outcomes.

The Dutch Fatigue Scale (DUFS) is a 9-item scale based on the 12 defining characteristics of fatigue outlined by the North American Nursing Diagnosis Association (NANDA) (Knippen, 1997). In a validation study with patients with chronic congestive heart failure (CHF), the DUFS was found to be a reliable and valid measuring instrument in relation to fatigue and one that could be useful for the comparison of group results (Tiesinga, Dassen, & Halfens, 1996b, 1997b, 1998; Tiesinga, Dassen, Halfens, & van den Heuvel, 1998).

The aim of this study was a further validation of the DUFS. To this end, the sensitivity, specificity, and usefulness of the DUFS were tested. The sensitivity and specificity of an instrument may be defined, respectively, as "the proportion of positives that are correctly identified

by the test" and "the proportion of negatives that are correctly identified by the test" (Altman, 1991, p. 410). Well-developed instruments measure phenomena with precision. A tool with strong reliability and validity tends to measure more precisely than a tool that is less well developed (Burns & Grove, 1993). Variance tends to be higher in a less well-developed tool than in one that is well developed. An instrument with smaller variance is preferred because the power of a test is always decreased by increased within-group variance (Kreamer & Thiemann, 1987).

The expectation confirmed in an earlier study was that the DUFS should be useful not only among patients with CHF but among other chronically ill and healthy people as well (Tiesinga, Dassen, & Halfens, 1998). Postpartum women were investigated in this study to support this hypothesis. In the literature, postpartum fatigue is mentioned as a mild to intense and frequently occurring symptom (Fawcett & York, 1986; Gardner, 1991; Lee & Zaffke, 1999; Milligan, Pugh, Bronner, Spatz, & Brown, 2000; Troy, 1999). In contrast to fatigue that is related to both physical and emotional components (e.g., chronic heart failure [Friedman, 1993; Schaefer & Potylycki, 1993]), postpartum fatigue may not be physical but rather situational or psychological (Gardner; Pugh, 1993).

Two types of subjects were studied to test the appropriateness of the DUFS as a disease-related or a generically useful measurement instrument. Comparisons of DUFS sumscores between both nonfatigued and fatigued subjects, as well as between patients with CHF and postpartum women, will give more insight into the usefulness of the DUFS as a tool for measuring fatigue among ill and healthy persons.

Further, different types of fatigue described in the literature (Tiesinga et al., 1996a) were used in this study. Different types of fatigue are expected to provide discriminating features in fatigue levels. Both the items composing the DUFS and the indicators that refer to the different types of fatigue are shown in Table 1.

Indicators of different types of fatigue have been described in the literature. The intensity of fatigue is shown as a continuum, progressing from tiredness, advancing to fatigue, before reaching exhaustion (Gardner, 1991; Lee, 1993; Rhoten, 1982). Tiredness can be seen as a universal sensation occurring normally in accordance with circadian rhythms and in response to activity or exertion (Piper, 1993). Exhaustion is an extreme state of fatigue. In nursing literature fatigue is identified as a diagnosis and not as a syndrome—for example, depression syndrome (Tiesinga et al., 1996a).

Although fatigue may be related to depression, conceptually it is only one dimension of the construct of depression. The predominance of fatigue may be experienced as an overpowering or minor sensation when compared to other problems (Piper, 1988). The patterns of fatigue are described as constantly fatigued (without intervals) and intermittently fatigued (with intervals) (Carpenito, 2000; Knippen, 1997; Piper, 1993). Fatigue also may be experienced in either a specific part of the body or as whole-body feeling, also described as generalized fatigue (Piper, 1988). Another indicator associated

Table 1. Items Constituting the DUFS and Indicators of Different Types of Fatigue

DUFS Items
■ Verbalization of an unremitting and overwhelming lack of energy
■ Perceived need for additional energy to finish required tasks
■ Inability to restore energy, even after sleeping
■ Decreased libido
■ Listlessness
■ Increase in rest requirements
■ Inability to maintain usual routine
■ Decreased performance
■ Impaired ability to concentrate
Indicators of Different Types of Fatigue
■ Intensity
■ Predomination
■ Pattern
■ Specificity
■ Explicability

with different types of fatigue is its explicability, or the extent to which the cause of fatigue can be explained by patients (Piper, 1989).

Research Questions

Five research questions were posed in investigating patients with CHF and postpartum women:

1. *What is the sensitivity and specificity of the DUFS at various cutoff points?*
   Hypothesis: Use of the median DUFS sumscore on the one hand and a criterion of fatigue on the other will render a sufficient calculation of the sensitivity and specificity.

2. *What are the average DUFS sumscores among nonfatigued and fatigued subjects?*
   Hypothesis: The DUFS sumscores will demonstrate significant statistical differentiation between the subgroups of nonfatigued and fatigued subjects.

3. *What are the average DUFS sumscores on the discriminating indicators—referring to the different types of fatigue?*
   Hypothesis: The average DUFS sumscores will be higher among the subjects who are intensely, predominantly, constantly, generally, and inexplicably fatigued.

4. *Are the differences in average DUFS sumscores between the female patients with CHF and postpartum women on the discriminating indicators referring to the different types of fatigue statistically significant?*
   Hypothesis: Because the DUFS is useful both for ill people (those with CHF) and for healthy subjects (postpartum women), the differences in average DUFS sumscores between the two groups will not be statistically significant.

5. *What are the correlations between the DUFS sumscores for all subjects and especially among the short-term fatigued subjects (<6 months) and the long-term fatigued subjects (>6 months) with the age and educational level of the subjects and the indicators referring to different types of fatigue?*
   Although some authors show evidence of significant correlations (Daugherty et al., 1991; Glaus, 1993), most literature reports no statistically significant correlation between age and fatigue (Cardenas & Kutner, 1982; David et al., 1990; Jones, 1993; Lee, Lentz, Taylor, Mitchell, & Fugate Woods, 1994; Valdini, Steinhardt, & Jaffe, 1987) or between the duration of fatigue and levels of fatigue (David et al.; Wessely & Powell, 1989).

The relationship between educational level and fatigue appears to depend on the conditions of the investigated population. For instance, Lee et al. (1994), studying fatigue among nonpregnant women between the ages of 18 and 45, and Jones (1993), studying patients with cancer and undergoing treatment with chemotherapy, found no statistically significant association between the fatigue of the cases and their level of education. In contrast with this finding, Gardner (1991), investigating postpartum women, found a negative and significant correlation between the educational level of the mothers and their levels of fatigue. The described correlates of fatigue are used as working assumptions to answer the research questions.

Methods

This study employed a cross-sectional design among patients with CHF (n = 138) and breastfeeding postpartum women (n = 75). Patients were selected in collaboration with cardiologists and home healthcare nurses. Data were gathered by questionnaire. The inclusion and exclusion criteria relating to the patients living at home who have with CHF and postpartum women are shown in Table 2.

Women completed the questionnaire 8 weeks after childbirth, the point at which researchers assumed most women are physiologically recovered. By extension, the fatigue experienced by postpartum women is

Table 2. Inclusion and Exclusion Criteria for Study Subjects

	Inclusion Criteria	Exclusion Criteria
Patients With CHF	■ Bad or moderate (40%) left ventricle ejection fraction ■ Diagnosed heart failure of at least 6 months duration ■ Dutch writing and speaking	■ Demented or mentally ill ■ In acute danger of losing life
Postpartum Women	■ Uncomplicated delivery ■ Dutch writing and speaking	■ Hospital admission related to pregnancy, delivery, or general medical condition ■ Perinatal complications for mother or child ■ Hospital delivery stay >24 hours

assumed to be more nearly related to psychosocial factors than is that of patients with CHF, among whom fatigue is explicitly related to physiologic factors, such as a low left ventricle ejection fraction or poor physical condition.

Procedures

To test the sensitivity and specificity of the DUFS, all subjects were questioned and subsequently differentiated on the criterion of their subjective level of fatigue. Questioned as to "How intensively fatigued are you?" (asked after the DUFS items and before the other indicators that refer to the different types of fatigue) 85 of the 138 patients with CHF (62%) answered they were fatigued or severely fatigued and 53 patients (38%) answered they were not fatigued. If the patients were not fatigued, subsequent questions concerning the types of fatigue were judged not applicable and consequently not filled in. Of the 75 postpartum women, 46 (61%) answered that they were fatigued or severely fatigued and 30 (39%) that they were not fatigued. Both groups of subjects showed a similar proportion of fatigued people within the sample ($n = 131$; 61%).

Besides measures of sensitivity and specificity, the positive and negative predictive values were calculated in this study. Positive predictive value may be defined as the proportion of patients with positive test results who are correctly diagnosed; a definition of negative predictive value is the proportion of patients with negative test results who are correctly diagnosed (Altman, 1991). The positive and negative predictive values give a direct assessment of the usefulness of the test in practice (Altman) (Figure 1).

Usefulness

The DUFS sumscores between the contrasted groups were compared and tested to estimate the usefulness of the measurement instrument. In addition, research questions referring to the different types of fatigue were put to the subjects and tested on DUFS sumscores to support the usefulness of the measuring tool. A number of sociodemographic factors, such as age and educational level, were examined in relation to fatigue and were compared to the literature.

Measures

The fatigue of the subjects was measured using the DUFS. Data derived from the patients with CHF were measured dichotomously and summed (range: 0–9). In another later study among postpartum women (Sillevis,

Figure 1. Calculating Predictive Value of a Diagnostic Test Using Fatigue as a Symptom

		Subjective Fatigue	
		positive	**negative**
Fatigue per the DUFS	**positive**	*a*	*b*
	negative	*c*	*d*

a = true positive

b = false positive

c = false negative

d = true negative

$$\text{sensitivity} = \frac{a}{(a + c)}$$

$$\text{specificity} = \frac{d}{(b + d)}$$

$$\text{positive predictive value} = \frac{a}{(a + b)}$$

$$\text{negative predictive value} = \frac{d}{(c + d)}$$

1998), a 5-point scale was substituted to measure fatigue (range: 0–36). The reason for using a 5-point scale was the growing interest in construct analyses of the data.

In order to compare the DUFS sumscores between the two investigated groups, the DUFS sumscores pertaining to the postpartum women were recoded from the 5-point scale to a 2-point scale on item level (0 through 1 = 0, 2 through 4 = 1).

Reliability of the transformation from 5-point scaling to dichotomous measurement among the postpartum women was tested using Pearson product moment correlation coefficients, which showed nearly similar results. The correlation of the DUFS sumscores between the two methods of measuring was sufficient (r = .95), and separate items achieved values ranging from r = .89 to r = .92.

Internal consistency, or homogeneity, is a form of reliability referring to the degree to which the subparts of an instrument all measure the same attribute or dimension (Polit & Hungler, 1995). The Kuder-Richardson-20 coefficient (KR-20) is the estimate of the internal consistency used for instruments that have a dichotomous response format. The KR-20 of the DUFS for all cases in this study was sufficient: .82 (standardized .83, N = 213) and for the separated groups of patients with CHF and postpartum women, respectively, .79 (standardized .80, n = 138) and .87 (standardized .87, n = 75).

The DUFS sumscores of both groups (N = 213) ranged from 0 to 9 ($\overline{X}$ = 3.0; SD = 2.6). The average DUFS sumscore of the patients with CHF (n = 138) included in this study was 3.1 (SD = 2.5; range: 0–9), and among the postpartum women (n = 75) it was 3.0 (SD = 2.9; range: 0–9). In addition, a checklist with indicators that referred to different types of fatigue was included in the questionnaire. Different techniques for statistical analysis were used to adequately answer research questions: diagnostic tests, t tests, and correlation coefficients.

Findings

The subjects with CHF ranged in age from 37 to 88 years ($\overline{X}$ = 68; SD = 11.1). The age of the postpartum women ranged from 21 to 40 years ($\overline{X}$ = 31; SD = 4.1). The average age of all subjects was 55 years. Of the 138 patients with CHF, 104 were males and 34 were females. Further, the two groups of subjects showed a difference in the duration of their experienced fatigue. In contrast to the fatigued postpartum women (n = 46), the duration of fatigue experienced by nearly all fatigued patients with CHF (n = 85) exceeded 6 months, 11% vs. 84%, respectively.

Sensitivity and Specificity of the DUFS

Calculations of the sensitivity, specificity, and positive and negative predictive values are given in Table 3. While the DUFS sumscores increase, the calculations of the sensitivity decrease. In contrast to the sensitivity, the specificity calculations increase when the DUFS sumscores increase. Using the median of the DUFS sumscores (score of 2.0) as the cutoff for ratio (which makes a distinction between fatigued and nonfatigued subjects), the sensitivity and specificity are 0.90 and 0.72, respectively. The calculations of the positive and negative

Table 3. Sensitivity, Specificity, Positive Predictive Value (PPV), and Negative Predictive Value (NPV) of the Diagnostic Test of Fatigue

Cut-Off for Ratio	Sensitivity	Specificity	PPV	NPV
1.0	0.97	0.45	0.73	0.90
2.0	0.90	0.72	0.84	0.82
3.0	0.74	0.88	0.91	0.68
4.0	0.57	0.98	0.97	0.59
5.0	0.41	1.00	1.00	0.52
6.0	0.32	1.00	1.00	0.48
7.0	0.27	1.00	1.00	0.47
8.0	0.14	1.00	1.00	0.43
9.0	0.05	1.00	1.00	0.43

predictive values at this cutoff point of 2.0 are 0.84 and 0.82.

Average DUFS Sumscores Among Nonfatigued and Fatigued Subjects

The subjects were classified into different categories on the basis of the question regarding whether subjects were fatigued or not. Subsequently, the average DUFS sumscores between the nonfatigued and fatigued subjects were compared in order to demonstrate the ability of the DUFS to discriminate (Table 4). Comparison of the average DUFS sumscores among the two subgroups showed a statistically significant difference both within the subgroups as well as throughout the group in total: patients with CHF ($t = -12.62$; $p<.001$), male patients with CHF ($t = -9.38$; $p<.001$), females with CHF ($t = -7.11$; $p<.001$), postpartum women ($t = -6.67$; $p<.001$), and the group as a whole ($t = -13.75$; $p<.001$).

Controlling selection bias of the gender factor, the average DUFS sumscores of only female patients with CHF and postpartum women were tested. The average DUFS sumscores of the nonfatigued and fatigued patients between the two subgroups were not statistically significant. Male patients with CHF, moreover, both nonfatigued and fatigued, showed lower average DUFS sumscores than the female patients with CHF and postpartum women: 0.94 (males) vs. 1.00 (female patients with CHF) and 1.03 (postpartum women), and 4.00 (male patients) vs. 5.07 (female patients) and 4.33 (postpartum women).

Average DUFS Sumscores and Different Types of Fatigue

Table 5 shows the DUFS sumscores of indicators referring to different types of fatigue. All categories within the investigated indicators confirmed the hypothesis: The DUFS has the capacity to discriminate among different types of fatigue. Not all results show statistically significant differences ($p<.05$). The DUFS sumscores among intensely, predominantly, and constantly fatigued patients with CHF is statistically significantly higher, 6.12 vs. 3.63, 4.58 vs. 3.29 and 5.19 vs. 4.00, respectively. Among the postpartum women, the intensely (7.20 vs. 3.98), predominantly (6.56 vs. 3.68), constantly (8.00 vs. 3.56), and inexplicably fatigued patients (6.60 vs. 3.58) showed statistically significantly higher DUFS sumscores ($p< .05$). No statistically significant DUFS sumscores were found between specifically and generally fatigued subjects among the patients with CHF or the postpartum women. A difference in average DUFS sumscores between the in-

Table 4. Comparisons of Average DUFS Sumscores Between Nonfatigued and Fatigued Subjects

	Nonfatigued			Fatigued			*t* Test	
	n	$\overline{X}$	*SD*	*n*	$\overline{X}$	*SD*	*t* Value	*p*
CHF (*n* = 138)	53	0.94	1.0	85	4.36	2.1	−12.62	<.001
CHF men (*n* = 104)	48	0.94	1.0	56	4.00	2.2	− 9.38	<.001
CHF women (*n* = 34)	5	1.00	1.0	29	5.07	1.9	− 7.11	<.001
Postpartum (*n* = 75)	30	1.03	1.3	45	4.33	2.9	− 6.67	<.001
Total (*N* = 213)	83	0.98	1.1	130	4.35	2.4	−13.75	<.001

vestigated groups is shown on the indicator "explicability"; patients with CHF showed no statistically significant DUFS sumscores related to explicable and inexplicable fatigue, while postpartum women showed statistical evidence ($p<.05$), as 4.17 vs. 4.59 and 3.58 vs. 6.60, respectively.

Comparing the average DUFS sumscores between the women with CHF and postpartum women on the identified indicators in relationship to the patients with CHF in total, the women again showed higher average DUFS sumscores than the men with CHF.

Average DUFS Sumscore Differences Among Subjects

Comparison of average DUFS sumscores on the discriminating indicators that referred to the types of fatigue between both patients with CHF and postpartum women, as well as female patients with CHF and postpartum women, showed no statistically significant mean differences, except when the feelings of fatigue were constantly present (Table 6). When fatigue was constantly present, postpartum women had significantly higher average DUFS sumscores than either of the two CHF groups: 8.00 vs. 5.19 ($p<.001$) and 8.00 vs. 5.60 ($p = 008$), respectively.

Although not statistically significant, the postpartum women showed higher average DUFS sumscores than the female patients with CHF if the manifestation was intense, predominant, generalized, or inexplicable.

Correlations With Age and Educational Level

For the purpose of determining whether the average DUFS sumscores correlate with age, educational level, and the indicators referring to the different types of fatigue, Pearson's rho correlation coefficients and Spearman's rho correlation coefficients were performed (Table 7). Correlation coefficients for age and educational level with the average DUFS sumscores also are given separately for the two populations.

In this study, no statistically significant correlation coefficients were found to exist between the age of the subjects and their average DUFS sumscores. The correlations between age and average DUFS sumscores within the subgroups of short- and long-term fatigued subjects demonstrated, respectively, for both the total group as well as for the patients with CHF and postpartum women separately, unequivocal positive (range: $r = .12–.24$) and negative correlation coefficients (range: $r = –.09$ to $–.17$). Within the group of short-term fatigued subjects, the impact of age on the average DUFS sumscores increased while within the group of long-term fatigued subjects the stated impact of fatigue decreased. The Spearman's rho correlation coefficient for all fatigued subjects in this study between the duration of fatigue (general) and the average DUFS sumscores was .050. For the subgroups of patients with CHF and postpartum women, the Spearman's rho correlation coefficients between duration

Table 5. Average DUFS Sumscores and *t* Tests on Different Form Indicators of Fatigue Among Women CHF Patients With Fatigue and Fatigued Postpartum Women

	CHF (*n* = 85)				CHF (Women) (*n* = 29)				Postpartum (Women) (*n* = 46)			
Indicators	***n***	$\overline{X}$	***SD***	***p***	***n***	$\overline{X}$	***SD***	***p***	***n***	$\overline{X}$	***SD***	***p***
Intensity												
▪ Not intense	69	3.87	1.9	<.001	20	4.45	1.7	.007	40	3.98	2.8	.019
▪ Intense	16	6.50	1.7		9	6.44	1.7		5	7.20	2.4	
Predomination												
▪ Secondary	14	3.29	2.0	.039	3	4.33	2.5	.495	37	3.68	2.8	.008
▪ Primary	71	4.58	2.1		26	5.15	1.9		9	6.56	2.7	
Pattern												
▪ Intermittent	59	4.00	1.9	.017	19	4.79	1.9	.290	39	3.56	2.7	<.001
▪ Constant	26	5.19	2.4		10	5.60	2.0		7	8.00	0.8	
Specificity												
▪ Specific	31	4.10	2.1	.387	11	4.64	1.4	.354	20	3.50	2.8	.138
▪ Generalised	54	4.52	2.2		18	5.33	2.2		25	4.84	3.1	
Explicability												
▪ Explicable	46	4.17	1.9	.377	19	4.79	1.7	.290	36	3.58	2.8	.003
▪ Inexplicable	39	4.59	2.4		10	5.60	2.3		10	6.60	2.2	

and average DUFS sumscores were –.054 and .190, respectively.

In contrast to the postpartum women and the group in toto, statistically significant and negative correlation coefficients were demonstrated between the educational level of the fatigued patients with CHF and the average DUFS sumscores.

For the total group and the subgroup of short-term fatigued subjects, the following indicators, referring to different types of fatigue, show statistically significant and positive Spearman's rho correlation coefficients with the average DUFS sumscores, respectively: intensity, predominance, and pattern. The impact of intense, predominant, and constantly present types of fatigue is substantial, though only for the subgroup of long-term fatigued subjects was the intensity statistically significant.

Discussion

The main conclusion of this study is that the DUFS may be used as a valid measurement tool to estimate accurately patients' fatigue both among ill subjects (patients with CHF) and healthy people (postpartum women). Calculations of the sensitivity and specificity in this study justify this conclusion. Although the DUFS has been developed and validated among ill subjects, this does not preclude its usefulness for the assessment of fatigue among healthy people. Further, the data support the usefulness of the DUFS, which discriminates, on the one hand, areas of statistical significance between nonfatigued and fatigued subjects, and demonstrates, on the other hand (with the exception of the scores among constantly fatigued postpartum women) nearly similar average DUFS sumscores between the two target

Table 6. Mean Differences in DUFS Sumscores, for the Different Types, Between CHF Patients With Fatigue (Women) and Postpartum Women

	CHF-Postpartum Women				CHF (women)-Postpartum Women			
Indicators	*Mean Difference*	*t*	*df*	*p*	*Mean Difference*	*t*	*df*	*p*
Intensity								
▪ Not intense	0.11	– 0.23	61	.835	0.48	0.81	56	.421
▪ Intense								
Predomination	0.70	– 0.74	19	.468	0.76	– 0.62	12	.507
▪ Primary								
Pattern	1.98	– 2.55	78	.013	1.40	– 1.71	33	.096
▪ Intermittent	0.44	0.93	96	.386	1.23	1.78	56	.081
▪ Constant								
Specificity	2.81	– 4.96	29	< .001	2.40	– 3.04	15	.008
▪ Specific	0.60	0.86	49	.395	1.14	1.25	29	.221
▪ Generalised								
Explicability	0.32	– 0.47	36	.639	0.49	0.58	41	.542
▪ Explicable	0.60	1.12	80	.288	1.21	1.70	53	.053
▪ Inexplicable	2.01	– 2.40	47	.020	1.00	– 0.98	18	.338

populations of patients with CHF and postpartum women.

That constantly fatigued postpartum women showed significantly higher average DUFS sumscores than the patients with CHF may be variously explained. In the literature, a positive relationship emerges between gender (women) and the level of fatigue (Belza, Henke, Yelin, Epstein, & Gilliss, 1993; Morrison, 1980; Ridsdale et al., 1993; Valdini et al., 1987). Most postpartum women are, in contrast to patients with CHF, suffering from short-term fatigue that increases the risk of ineffective coping and consequently results in higher levels of fatigue. More specific health problems may be diagnosed during the postpartum period (e.g., *ineffective breastfeeding, interrupted breast - feeding, disturbed sleep pattern, impaired home maintenance, disturbed body image, parental role conflict, risk for impaired parenting, ineffective sexuality patterns, or spiritual distress*) (NANDA, 2001) that increase postpartum fatigue. Regarding these potential health problems and the duration of fatigue of the postpartum women, it is not surprising that function and ability to restore energy may be inadequate in these women, resulting in higher levels of fatigue among the constantly fatigued subjects. The nursing interventions classification (NIC) that gives priority to "energy management" as the intervention of choice for fatigued people concurs (McCloskey & Bulechek, 2000; Tiesinga, Dassen, Halfens, & van den Heuvel, 1999).

The impact of intensely, predominantly, and constantly present types of fatigue is substantial, though the intensity statistically significant only for the subgroup of long-term fatigued people. This fact illustrates the idea that in time fatigued people can learn to cope with their fatigue, even when its existence is predominant, constant, generalized, or inexplicable.

A further remarkable finding is that the nonfatigued subjects in this study failed to show zero-average DUFS

Table 7. Correlation Coefficients for Age, Educational Level, Indicators of Different Types of Fatigue According to Extent of Fatigue

	Fatigue of General Duration			Short-Term Fatigue			Long-Term Fatigue		
Variables	***r***	***p***	***n***	***r***	***p***	***n***	***r***	***p***	***n***
Age	<–.001	.995	208	.116	.427	49	–.173	.135	76
▪ CHF	–.016	.856	138	.236	.416	14	–.088	.465	71
▪ Postpartum women	.106	.383	70	.168	.335	35	–.137	.826	5
Educational level	–.148	.031	213	–.150	.278	54	.005	.967	76
▪ CHF	–.277	.001	138	–.568	.034	14	–.082	.498	71
▪ Postpartum women	.144	.216	75	.054	.740	40	.763	.133	5
Intensity	.725	<.001	213	.430	.001	54	.492	<.001	76
Predomination	.279	.001	131	.444	.001	54	.192	.096	76
Pattern	.324	<.001	131	.429	.001	54	.237	.039	76
Specificity	.158	.073	130	.305	.027	53	–.020	.861	76
Explicability	.210	.016	131	.386	.004	54	.063	.589	76

sumscores. The fact that nonfatigued subjects have average DUFS sumscores ranging from 0.94 to 1.03, illustrates that fatigue—in this case more conceptualized as tiredness—may be seen as a normally occurring experience of life as an aspect of circadian rhythm. Human beings are expected to be more or less tired from time to time, place to place, and situation to situation. On the other hand, there will arrive a point of "negative effect" tiredness that decreases the ability of the person to perform physical and psychosocial activities, thus contributing to, or triggering, cases of increasing levels of fatigue or exhaustion.

The sociodemographic variables demonstrated the expected correlations. The average DUFS sumscores of the women concurred with the literature and were higher than the scores of men. Further, no statistically significant correlation coefficients were found between the age of the subjects and their average DUFS sumscores. Within the group of short-term fatigued subjects, the impact of age on the average DUFS sumscores was found to increase, while the impact of age decreases within the group of long-term fatigued subjects.

There was no further unequivocal correlation between the education level of the subjects and their average DUFS sumscores: The patients with CHF showed a negative and statistically significant correlation, while the postpartum women showed a positive but not statistically significant correlation. A reason for this may be found in the life situation existing within the investigated subgroups. It seems plausible that more highly educated postpartum women have more responsibilities within the community, resulting in work outside their home, while the working career of the majority of patients with CHF has already come to an end.

Although the results of the present study are convincing, directive, and useful for diseased patients and healthy subjects, more research needs to be conducted for estimation of the cutoff points of the DUFS sumscores

that might disclose precise discriminating variation between nonfatigued and fatigued subjects, which might justify an intervention program for patients in clinical settings.

Conclusion

The DUFS is a sensitive, reliable, and valid measurement tool for the assessment of *fatigue* in both people with a disease (e.g., CHF) and healthy people (e.g., postpartum women). Further, this study showed a strategy of how to develop and validate a measurement tool that is based on the defining characteristics of the NANDA diagnosis of *fatigue*.

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